Aa Bb Cc Dd Ee Ff Gg Hh Ii Jj Kk Ll Mm

Nn Oo Pp Qq Rr Ss Tt Uu Vv Ww Xx Yy Zz

Teaching with Technology in Elementary Mathematics

An Honors Thesis (HONORS 499)

by

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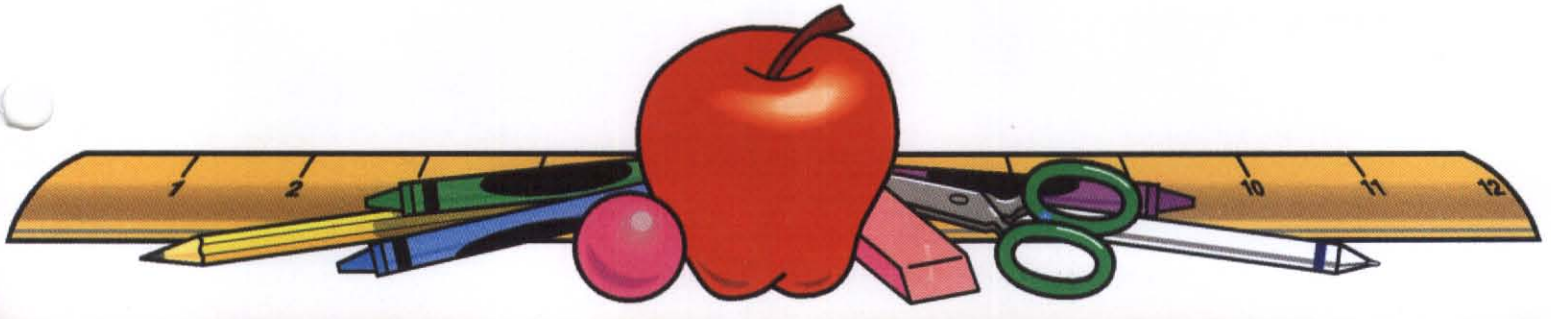

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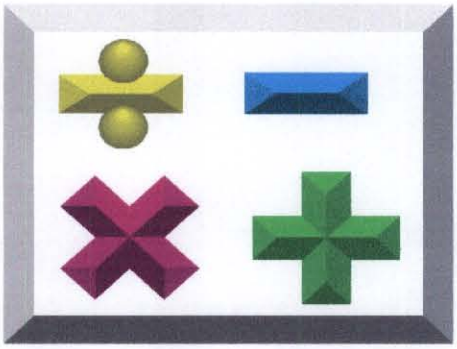

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Dear Teacher:

I would first like to thank you for participating in my survey about teaching with technology in the fall. The survey, along with further research, and personal interests guided me in creating this packet that I call "Teaching with Technology in Elementary Mathematics." Within this packet, I have enclosed some information about the transition of technology and the importance of using technology while teaching. I have also researched and/or created seventeen lesson plans that can be used in your classroom that integrates technology while teaching math, containing a variety of calculator, Internet, and software activities. I will further explain the basis of these activities in the next paragraph. At the end of the packet, I have also enclosed an article called *Technology Turnaround,* written by myself regarding my experiences, research, my educational aims, and goals for the future.

The activities for use in your classroom were developed to follow the NCTM standards. Among the five major subjects that NCTM uses in the math program, there are seventeen sub-standards and then further expectations for students. For this project, I focused on the seventeen sub-standards. I have developed one lesson per sub-standard, and have listed the standard at the beginning of each lesson. After writing a detailed description of the lesson, any additional worksheets or useful information can be found directly after the lesson. I chose to complete these activities for the grades three through five standards. Some of the activities fall at the low end of this scale, and some at the very top end. However, these activities can all be changed or adapted to fit the needs of a wide range of students.

Once again, thank you for contributing to my research as part of my Honors Undergraduate Fellowship and Thesis Project. Your help is much appreciated. I am honored to share this packet with all of you and hope that you will enjoy this packet and take the activities into consideration for using in your own classroom. It has been a privilege to complete this project and to work with all of you. Please let me know what you think about it. Please contact me with any additional questions or information.

Sincerely,

Brenda Gehret

Brenda Gehret
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The Transition of Technology

What has changed since the 1950's?
(a half century)

A transition from....

An Industrial Age

to

An Information Age

General life skills needed in an Industrial Age...

- precise repeated procedures
- ability to learn how to do something and do it
- MIND SET: build to last
- local perspective (America)
- staff – work at the company (time clock)
- fixed system

General life skills needed in an Information Age...

- few defined procedures
- ability to sort, sift and synthesize – Efficiently
- MIND SET: build to upgrade
- global perspective (Worldwide)
- work at home and company
- dynamical system, constant change

The Workforce of the 21st Century

- many careers in a lifetime
- multi-locations, worldwide
- flexibility, yet productive (notion of efficiency)
- problem solving now a skill
- informed citizens

Goals for Students

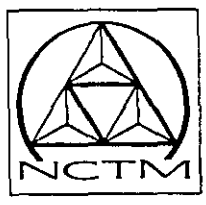
Goals for All Students

To learn to:

- value mathematics
- communicate mathematically
- reason mathematically

To become:

- confident in their ability to do mathematics
- mathematical problem solvers



Major Shifts

In curriculum:

Toward a deeper study of important mathematics and its uses.

In learning:

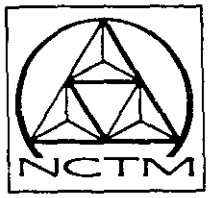
Toward active student engagement with a variety of mathematical tools for solving these problems.

In teaching:

Toward creating stimulating learning environments in which all students are challenged to reach their full potential.

In assessment practices:

Toward assessment that is ongoing and based on many sources of evidence.



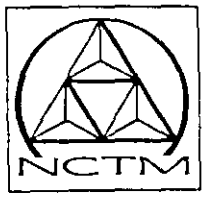
The classroom...

- Worthwhile mathematical topics and problem situations
- Students engaged in active learning
- Environments that support learning
- Assessment that is ongoing and based on multiple sources of evidence

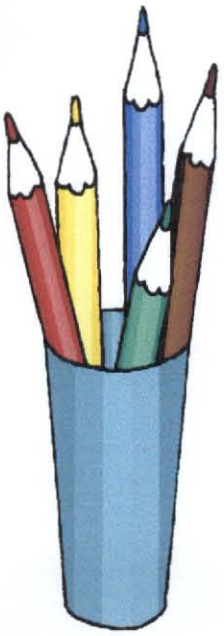
...for every child.

Impact of Technology on the Mathematics Curriculum

- Some mathematics becomes *more important* because technology *requires* it.
- Some mathematics becomes *less important* because technology *replaces* it.
- Some mathematics becomes *possible* because technology *allows* it.



Activities for your Classroom



Reading Between the Lines

Standard:
Number and Operations: Understand numbers, ways of representing numbers, relationships among numbers, and number systems.

Materials Needed: multi-link cubes, graph paper, TI-15 Calculator, *A Remainder of One* by Elinor Pinczes (optional)

Directions:

Students will be engaged in the manipulative stage, pictorial stage, and symbolic stage.

After reading *A Remainder of One*, revisit the story by using multi-link cubes to represent each of the squadrons described in the book. Ask students to describe the formations. For example, two rows of twelve and one remaining.

Next, ask students to trace each formation on graph paper and cut out each shape. Students can then record the problem on each squadron shape. For example, 25 divided by 2 = 12 r 1. Using the TI-15, students can create the same problem with the INT divide key. This provides reinforcement for the symbolic stage and the necessary connection to the manipulative and pictorial stages.

Students can examine the representations of division on the TI-15 (integer divide, division with quotients expressed in fraction form using the Mode key, and division with quotients expressed in decimal form using the Mode key). Start with 25 divided by 3 and continue on with others, looking for patterns in the representations on the TI-15. (For example: 8r1, 8.333333333, 8 1/3) Scroll up or down.

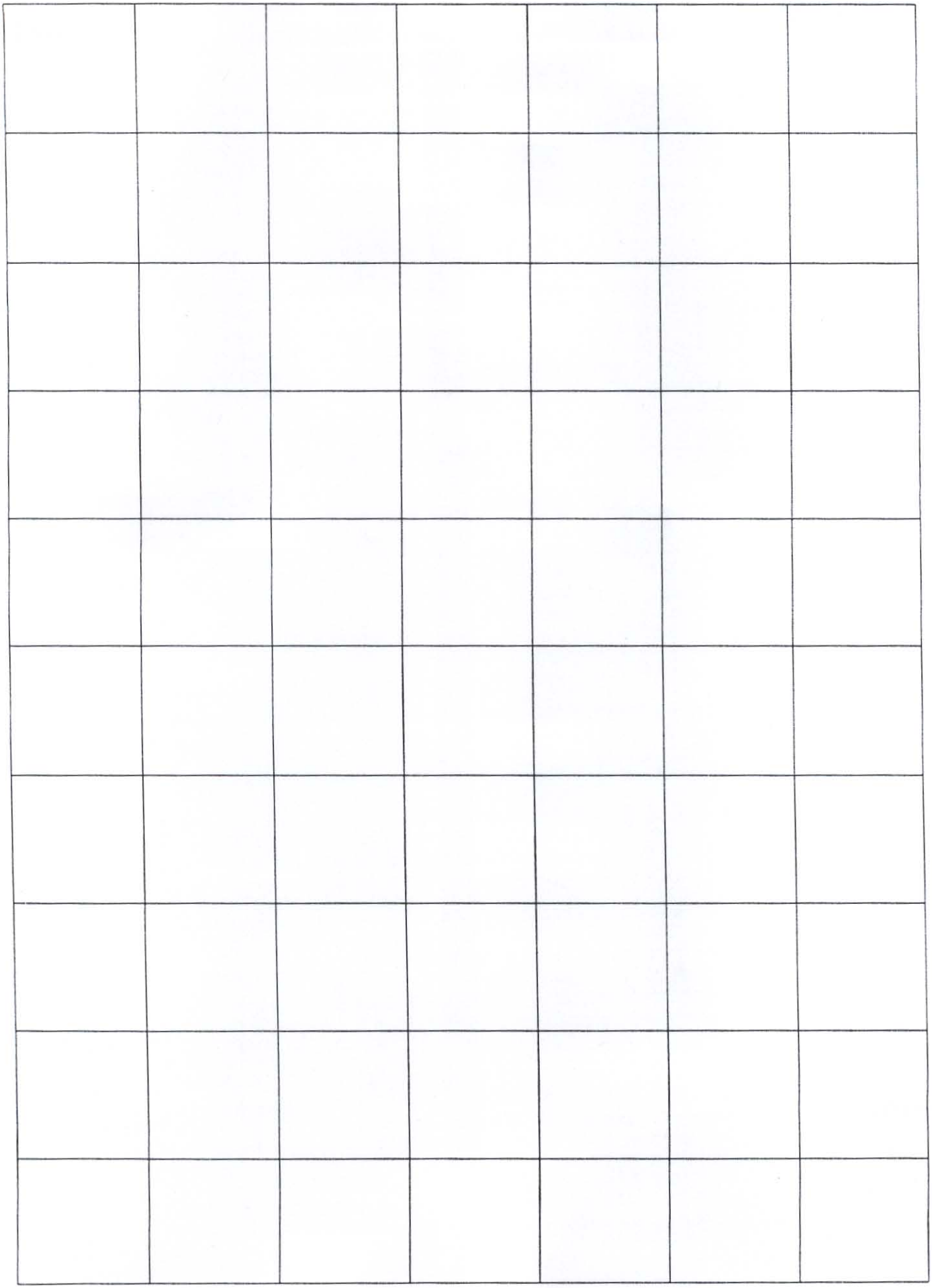
Discuss with students the importance of the context of the problem, and which result of division would be appropriate to use. For example, when the context involves people and animals, would it be more appropriate to have an answer in fractions, decimals, or whole numbers with remainders?

Extension Activities:

In addition, ask students what geometric shape is represented when there are no remainders in the 25th squadron? How many members would be in the next larger squadron of the same shape? What about the next, and so on?

Reference:

Thanks to Chris Ruda, Teachers Teaching with Technology (T3) Instructor



Texas Instruments

education.ti.com

TI-15

Printed in U.S.A. • Imprimé aux Etats Unis.
Impreso en los E.U.A. • Impresso nos E.U.A.

Willoughby Wanderings

Standard:
Number and Operations: Understand meanings of operations and how they relate to one another.

Materials Needed:
Computer with Internet Access

Directions:
Open the following site on Internet Explorer:
http://schoolcentral.com/willoughby/default.htm
Scroll down the page and you will see a heading that says Elementary Math Tutorials towards the right side of the page. Under this heading, click on the Multiplication Tutorial link.
From this page you can begin a six-stage multiplication lesson to see visual examples and answer questions based on analyzing the pictures. It also will move to a drill section to review multiplication and then offer problem solving with multiplication!

Extension Activities:
Students could create their own problems and quizzes with visual representations to be used in the classroom.
Students may also go through the additional multiplication drill activity called Stanley Park Walk and the division activity called Victoria Run. These can both be found at the homepage under Elementary Math Tutorials!

Reference:
Thanks to Willoughby Elementary School and their website http://schoolcentral.com/willoughby/default.htm

Swim the Lake

Standard:
Number and Operations: Compute fluently and make reasonable estimates.

Materials Needed: *TI-15* per group, Swim the Lake gameboard (attached), markers (colored beans work well), teams (one person per team is a nice number).

Directions:

Using the *TI-15*, push the diamond key just below the On/Off button, as follows.

This will start a game. The game will ask you to find the answer to the missing number in the equation (varies from either side of the equal sign). To answer the question, simply push the answer and then the Enter key. On the screen, it will display your answer in the equation, along with either YES or NO, and also a clue that tells you if it is higher or lower (using a < or > sign). There are three chances to every problem. After three chances, the correct answer will appear in the equation. By using the Mode key, you can alter the game by operation (+, -, x, or /) and by level (1, 2 or, 3).

To play the game, put students into groups of two. Each person will make his or her own team. The object of the game is to get across the lake first. When a problem is answered correctly on the calculator, locate the answer on the "lake" and put a marker there. If the answer is 2 or 3 digits, you can use the one's digit. If a number is already used up, you can then turn to the ten's digit or hundred's digit, if applicable. If you answer the problem incorrectly, you lose your turn. In order to be across the lake, a path must be formed from the markers vertically, horizontally, diagonally, or a combination of these. All markers must form a path by connecting square to square..

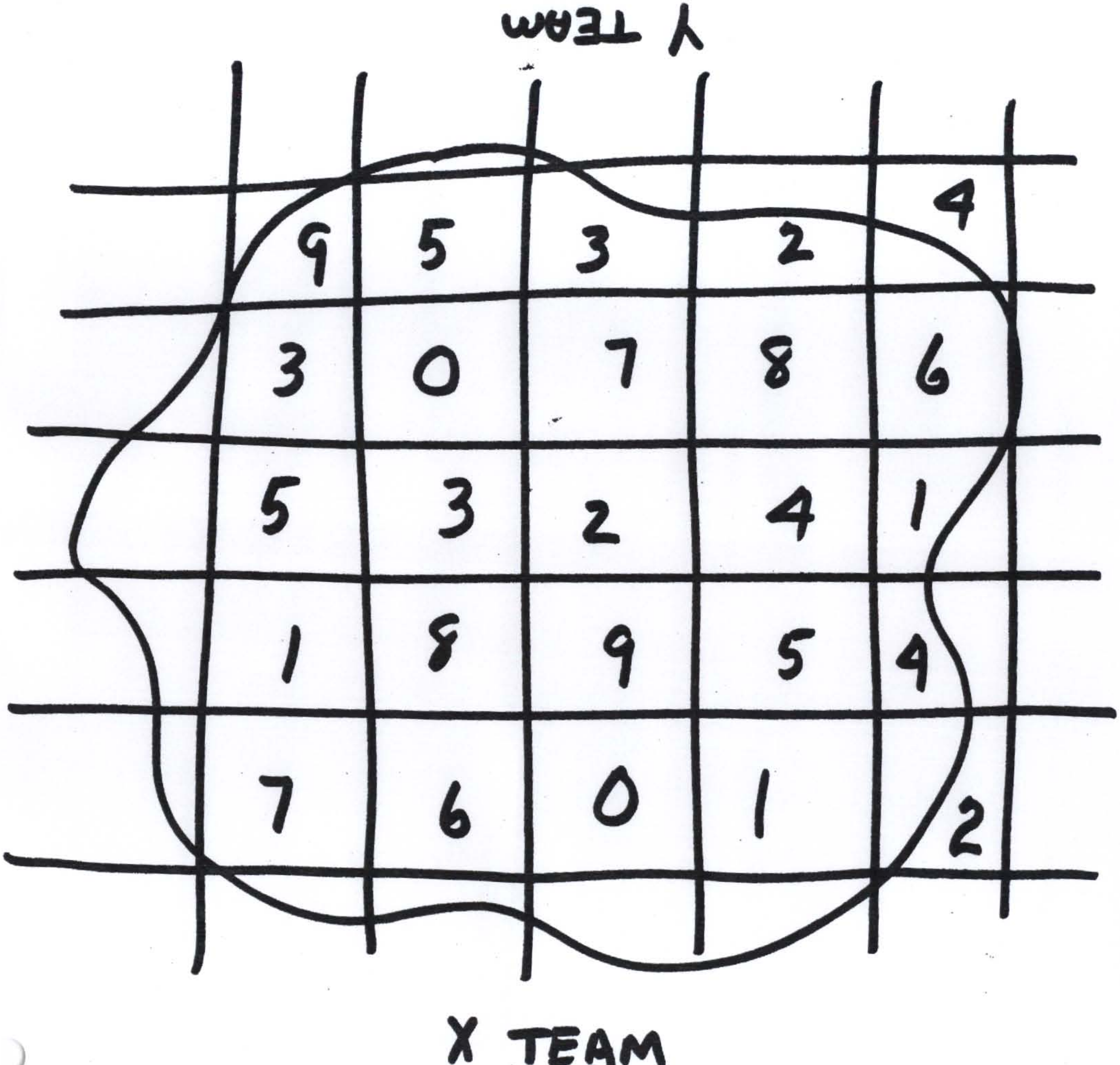
Using the calculator, begin playing the game by answering a question and taking turns. Students can help one another after the first try in order to find the correct answer to the problem.

Extension Activities:

Boards can be recreated with a different variety of numbers or to create a larger lake of numbers.

Reference:

Thanks to Bob Garvey, Teachers Teaching with Technology (T3) Instructor


Y TEAM
9 5 3 2 4
3 0 7 8 6
5 3 2 4 1
1 8 9 5 4
7 6 0 1 2
X TEAM

Weaving Patterns

Standard:
Algebra: Understand patterns, relations, and functions.

Materials Needed: *Annie and the Old One* by Miska Miles (optional), hundreds number chart (attached), highlighter or crayon, strips of paper that are 1 inch by 10 inches, calculator.

Directions:

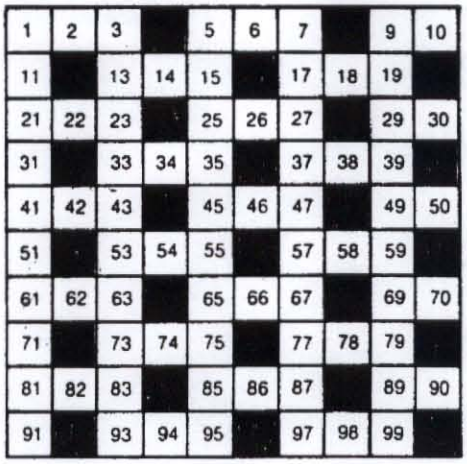
After reading *Annie and the Old One*, students can make a hundreds number chart through paper weaving, which will highlight multiples of different numbers.

Begin by having students plan their own pattern design on a hundreds chart. Students can use calculators to determine patterns or multiples or to check their own design. For example, multiples of four can be found by entering +4, =, =, =, … into the *Texas Instruments 108* calculator. On the *TI-15*, students can enter OP1, +4, OP1, 0, OP1, OP1… which will continuously show the next number in the pattern, including the display of how the number is formed.

To begin weaving, students will use one color for the vertical framework and another color for the horizontal strips that will be the ones woven through. Students will place 10 vertical strips down into a square. They will next weave the first strip at the top, allowing the color to appear at the number they have chosen to start their pattern with. As an example, if the pattern was to add four each time, the weaving would consist as follows for the first row: under 3, over 1, under 3, over 1, under 2. For the second line, the weaving would be: under 1, over 1, under 3, over 1, under 3, over 1. The process continues until you have completed a square. Every multiple of four will show up as the same color. Strips can then be glued or taped together. This creates a visual display of a number pattern! (Example below)

These weaving patterns can be arranged and displayed where students can see them. Discuss the different things students notice about the patterns and differences among the patterns.

Example:



1	2	3		5	6	7		9	10
11		13	14	15		17	18	19	
21	22	23		25	26	27		29	30
31		33	34	35		37	38	39	
41	42	43		45	46	47		49	50
51		53	54	55		57	58	59	
61	62	63		65	66	67		69	70
71		73	74	75		77	78	79	
81	82	83		85	86	87		89	90
91		93	94	95		97	98	99	

Extension Activities:

Use the data on the display to ask further questions to challenge students. For example, pick any number, such as 44. What is 44 a multiple of? How can you tell? You can continue with other numbers.

Also, if 44 is a multiple of 2, is it divisible by 2? Check with a calculator. Is this always true? If 44 is not a multiple of 3, is it divisible by 3? Is this always true?

Reference:

Thanks to Chris Ruda, Teachers Teaching with Technology (T3) Instructor

100 CHART

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Fun with Calendars

Standard:
Algebra: Represent and analyze mathematical situations and structures using algebra symbols.

Materials Needed:

Computer with Internet access, overhead transparency calendar (example of one attached). Students will need to have background knowledge in solving equations in algebra in order to complete this activity.

Directions:

Show students the calendar on the overhead and tell students you are going to play a trick on them. Ask a student to follow the directions on the overhead by choosing four days that form a square, as shown. Have the student add up the four digits and only tell you the sum. Then proceed to tell them what the four days are. Continue with several students. An example and explanation of trick is attached.

Have students figure out how you were able to play the trick by exploring the following website: http://math.rice.edu/~lanius/Lessons/calen.html. After they have followed all the directions and know how to do it, click on the bottom of the page on the link that says **Next: You try** to try to practice the trick on the computer. There is the link to check the answer, **Next: Check your answer.**

Extension Activities:

Students can quiz themselves within groups with this problem by asking each other to find the dates on the calendar of given sums.

In addition, after checking the answer, an additional page is provided, using the **Next: Design your own puzzle**. There are suggestions for students to create their own puzzles that also utilize a calendar.

Reference:

Thanks to Cynthia Lanius and website
http://math.rice.edu/~lanius/Lessons/calenpr.html

Algebra - Fun with Calendars

April 03

S	M	T	W	TH	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

Choose 4 days from the calendar that form a square like the four to the right.

18	19
25	26

Tell me only the sum of the four days, and I will tell you what the four days are.

These pages were developed through GirlTECH, a teacher training and student technology program sponsored by the Center for Excellence and Equity in Education (CEEE).

Thanks to the RGK Foundation for its generous support of GirlTECH.

URL http://math.rice.edu/~lanius/Lessons/calenpr.html

Teacher Cheat Sheet

Algebra - Fun with Calendars

April 03						
S	M	T	W	TH	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

(Calendar script may not work correctly with Internet Explorer.)

A fun mathematical puzzle to play with your friends.
(Or teachers, with your class.)

Take ***any*** calendar. Tell your friend to choose 4 days that form a square like the four to the right. Your friend should tell you only the sum of the four days, and you can tell her what the four days are.

18	19
25	26

How does the puzzle work? You know how people always want to see a use for algebra? Well this puzzle uses algebra. Here's what I mean.

Let's pretend that the 4 numbers that the person chose were the highlighted ones here - 18, 19, 25, and 26. She adds up the four numbers and tells you only that the sum is 88.

You make a couple of calculations and tell her the numbers. What calculations? Lets figure that out with algebra. Let's call the first number ***n***. Then you know that the next number would be ***n + 1*** and the next number would be ***n + 7*** and the next number would be ***n + 8***. We had our friend add up the four numbers, so let's add our four numbers:

$$n + n + 1 + n + 7 + n + 8$$

And since our friend got 88 when she added them, let's make our sum equal 88:

$$n + n + 1 + n + 7 + n + 8 = 88$$

Simplify our equation by adding like terms:

$$4n + 16 = 88$$

How would you solve this equation? Subtract 16 from both sides?

$$4n = 72$$

Divide both sides by 4?

$$n = 18$$

Subtract 16 and divide by 4. That's exactly how you solve the puzzle. When your friend tells you the sum, you subtract 16 then divide by 4. This gives you the first number ***n***. (Then add 1 and 7 and 8 for the other numbers).

Alternate and easier method: Subtracting 16 mentally isn't so easy. Go back to that equation:

$$4n + 16 = 88$$

I think I see a better way. Factor 4 from the left side of the equation:

$$4(n + 4) = 88$$

Now, I could divide both sides by 4:

$$(n + 4) = 22$$

Subtract 4 from both sides.

$$n = 18$$

That's a *lot* easier to do mentally. **Divide by four and then subtract 4.**

Summary: So how does the puzzle work again? Your friend adds any 4 numbers that form a square on the calendar and tells you the sum. You **divide by four and then subtract 4.** That gives you the first number. You add 1, 7, and 8 to get the other numbers.

And algebra makes it all possible.

How Do You Measure Up?

Standard:
Algebra: Use mathematical models to represent and understand quantitative relationships.

Materials Needed:

Tape measure or yardstick, packet containing table and questions (attached), *TI-83* (the *TI-80* or *TI-82* would also work)

Directions:

The problem:

In this activity, you will investigate the relationship between a person's height and arm span (the distance from fingertip to fingertip of a person's outstretched arms).

To begin, you will need to collect data on both quantities from several members of your class.

Using a tape measure or meter stick marked in centimeters, determine the heights and the arm spans, to the nearest whole centimeter, of two or three members of your class.

Students will need to record the measurements in Table 1 and complete the table with measurements collected by other members of the class. When table is full, questions 1-4 on worksheet should be answered.

In addition to examining lists of numbers, it is often helpful to display data in a graph or plot and look for visual clues that might suggest possible relationships between two variables. One way to graph paired data, like the height and arm span measurements, is to construct a scatterplot. A scatterplot is simply a graph of all the ordered pairs of data on a single coordinate system. Before you plot the data, it is important to examine the data for maximum and minimum values so that appropriate measurement scales can be determined for the axes on the coordinate grid.

By working in groups, students will determine an appropriate scale for each of the horizontal and vertical axes and draw the scatterplot in question 5. Plot all the information recorded using height along the horizontal axis and length of arm span along the vertical axis. Next, answer questions 6-10.

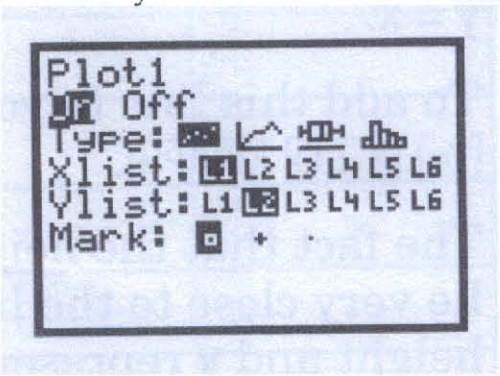
Calculator technology can also be useful in searching for relationships between two quantities like height and arm span. In fact, your graphing calculator can draw scatterplots like the one you created. To do so, you must place your data into the calculator's **LIST** storage. (Note: with proper equipment, the *TI-83* can be hooked up to an overhead projector and the activity can be completed as a whole class.

Calculating the Results- Follow these directions with students for using the calculator.

1. Press **STAT 4:ClrList 2nd [L1] , 2nd [L2] , 2nd [L3] ENTER** to clear the needed lists. (The third list **L3** will be used to store additional values computed later in this activity.)
2. Press **STAT 1:Edit** to gain access to the calculator's list storage.
3. Type the numbers representing student *heights* into the first list (**L1**) on your calculator. Type a number, press **ENTER** and repeat until all numbers have been entered.
4. Press ⇨ to move to the second list. Type the numbers representing student arm spans into the second list (**L2**). Be sure to enter the *arm span* for each student on the same row as the student's height.

Once the paired data have been entered, you need to enter information on two windows before the calculator can produce a scatterplot graph. First, you must tell the calculator you want it to draw a scatterplot, and then you must define the intervals and the scales you want it to use for the coordinate system, just like you did when you drew a scatterplot on paper.

1. Press **2nd [STAT PLOT] 1:Plot 1** to select **Plot 1.**
2. Edit the window so that yours looks like the one at the below.



To highlight a selection, use the blue arrow keys to move the blinking cursor to the desired location and press **ENTER**. The first section represents the scatterplot.

3. When you have finished making the changes in **Plot 1**, press **WINDOW** and edit the numbers to match those you used when you constructed the scatterplot on paper.

Note that **Xmin** and **Xmax** refer to the minimum and maximum values to be used along the horizontal axis height. **Xscl** defines the distance between reference or *tick* marks used along that axis. **Ymin, Ymax,** and **Yscl** define the same parameters for the vertical axis. * Record your selected values in the window shown in question 11.

4. Press **GRAPH** to view the scatterplot.

5. You can view the coordinates of points on this plot by pressing **TRACE** and using ⇨ and ⇦ to highlight different points. Check that the traced values agree with those you have collected. When you examined your paper version of this scatterplot, you were asked to draw a line that connected points where the first and second coordinates were equal. To do this on your calculator, you will need to add the graph of the line defined by **y = x .**

6. To add this line to your scatterplot, simply press **[Y] X,T,O GRAPH.** The fact that the height and arm span data seem to lie very close to the line **y =x** (where x represents height and y represents arm span) is an interesting finding. In fact, it is just this type of algebraic relationship that statisticians are often looking for when they examine sets of paired data. Sometimes in the search for such relationships, it is helpful to examine the ratios of two quantities being studied.

In this study, you are comparing height and arm span so let's use the calculator to compute the ratio of arm span to height for each class member for whom you have collected data.

7. To obtain this list of ratios:

a. Press **STAT 1** to gain access to the calculator's list storage.

b. Press ⇨ twice to move to **L3**.

8. Press ⇧ to move to the top so that **L3** is highlighted.

9. Press **2nd [L 2] / 2nd [L 1] ENTER** to define **L3** as a list of rations of height to arm span.

Finally, finish the worksheet by answering questions 12-15.

Extension Activities:

For additional exploration, considering the following: Do you think there is a relationship between a person's height and the length of their shoe (shoe length, not shoe size)? Investigate this question by using the same methods used previously.

Reference:

Thanks to Texas Instrument *Explorations: Graphing Calculator Activities for Enriching Middle School Mathematics*

How Do You Measure Up?

Name: _____

Table 1: Height and Arm Span

Name	Height (cm)	Arm Span (cm)
Example: Jill	158	156

1. How often is a person's height greater than their arm span?

2. How often is height less than arm span?

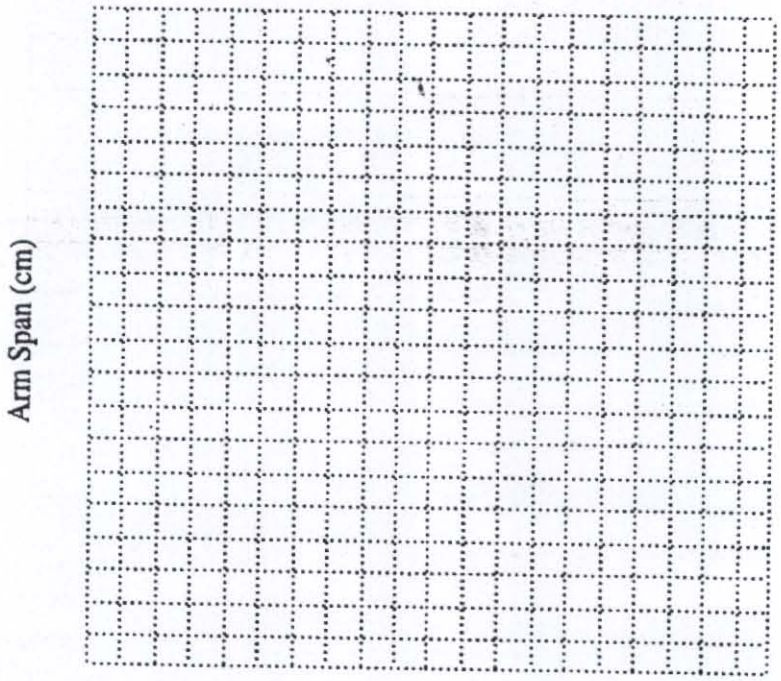
3. How often are height and arm span equal?

4. Do you see any other relationships between height and arm span? Describe these below.

****

5.

Scatterplot of Height Vs. Arm Span



6. In general, as height increases, what happens to arm span? How is this illustrated in the scatterplot?

7. In what ways does the scatterplot, when compared to the table of data, make it easier to see relationships between height and arm span?

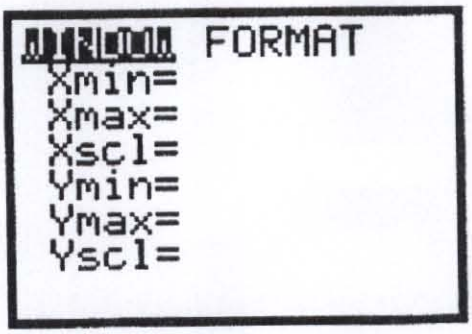
8. Find three of four points on your coordinate system (they do not have to be points of the scatterplot) where the horizontal and vertical coordinates are equal, for example (150, 150). Draw a straight line through these points; this will serve as a reference line for comparing heights to arm spans. Some of the points of the scatterplot lie above this line, some lie below this line, and others may lie on this line. Find several points that lie above this line. What is true about the relationship between height and arm span for each of these points?

9. How would you describe the relationship between height and arm span for points that lie below the line?

10. If a point lies on this line, what relationship exists between height and arm span?

****

11. Record your settings for the Plot Window:

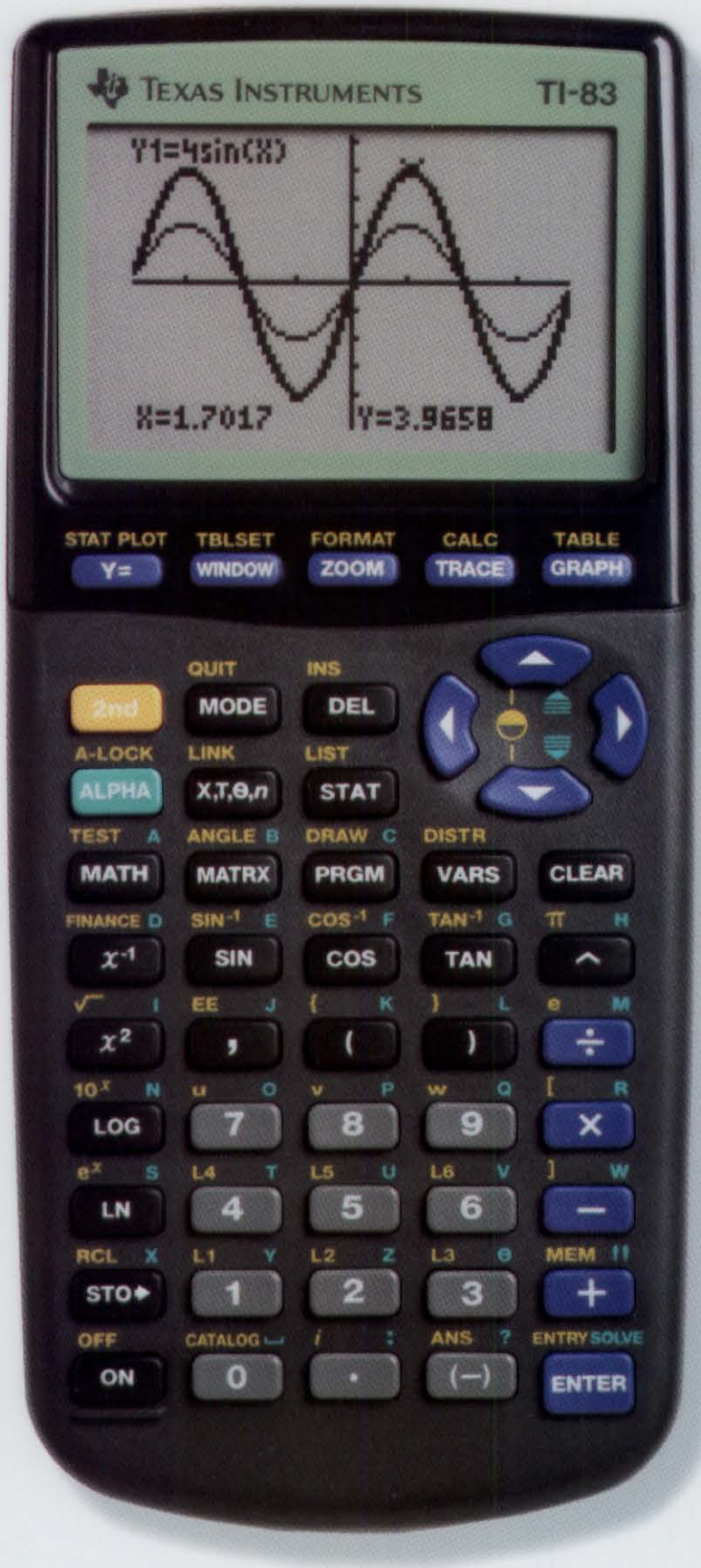


12. Explain why the line y = x contains points where the two coordinates are equal.

13. Find a value in **L3** that is less than 1. What is the relationship between the height and arm span used to calculate this value?

14. If we assume that **L2 / L1 = 1**, what relationship exists between arm span and height?

15. Based upon this relationship, predict the arm span measurement for a person who is known to be 170 cm tall? How often do you think your estimate would be too high? Too low? Explain your responses.



TEXAS INSTRUMENTS

TI-83

1071453-1301

Changing Graphs

Standard:
Algebra: Analyze change in various contexts.

Materials Needed:
Computer with Internet access, worksheet (attached).

Directions:
Give each student or group of students a copy of the directions and worksheet.

Students will follow the directions on the page to enter three different equations to be displayed on the graph on the following website: http://algebrahelp.com/. Upon completion of entering the equations and viewing the graphs, students will make observations by answering the questions on the worksheet.

After all students are completed, discuss the observation questions as a whole. Changes of variables and the affects on the graphed line may be a topic of conversation, as well as slope, and x and y-intercepts.

Extension Activities:
Students can use the website to further explore equations and graphical representations.

Reference:
Created by Brenda Gehret with the help of Algebra.Help located at http://algebrahelp.com.

CHANGING GRAPHS

Directions:

On Internet Explorer, go to the following website:

http://www.algebrahelp.com/index.jsp

Click on Calculators in the blue box on the right side of the screen.

Scroll down through Calculator Index and click on Equation Graphing Calculator

Finally, click on Proceed to the equation graphing calculator located in the bottom right hand corner of the page.

Steps:

1. Enter y=2x into the Equations box (you must use all lowercase letters in equation).
2. Click on the Solve and Graph box to view the graph (a new screen should appear).
3. Observe how y=2x appears on the graph.
4. Next, push on Close and enter y=4x on a new line in the Equations box.
5. Click on Solve and Graph box to view the graph. Each equation will appear on the graph in a separate color. Make observations for y=4x and compare the two lines.
6. Close this box and enter y=4x-7 on a new line in the equations box. Click on Solve and Graph box to view the graph with all three lines.
7. Finally, while viewing the graph, answer the questions on the following sheet of paper.

CHANGING GRAPHS

Name: _____

1. How are the three lines on the graph similar?

2. How are the three lines on the graph different?

3. Where does each graph cross the x-axis (the horizontal line)? _____

3. Looking at the similarities between the green (y=4x) and blue (y=4x-7) lines, why do you suppose these two equations create similar graphs?

4. Why do you think the red line (y=2x) is at a different slant than the other two lines?

Fractions and Quilting with Tangrams

Standard:
Geometry: Analyze characteristics and properties of two- and three- dimensional geometric shapes and develop mathematical arguments about geometric relationships.

Materials Needed:
4" x 4" squares of construction paper (at least 2 colors), commercial set of tangram sets (pattern attached), scissors, glue, *TI-15* calculator, *The Patchwork Quilt* by Valerie Flournoy (optional).

Directions:
A tangram is a seven piece Chinese puzzle. Each tangram is shaped so that it can be part of a whole square. It is believed that tangrams were names after Tan, a legendary Chinese scholar.

Distribute tangram sets to students. Ask them to observe the number of pieces and to use all pieces to form a square. After a brief time period, explain to the students that they will explore solving the problem in groups.

Distribute squares of one color of construction paper. While modeling, instruct students in folding and cutting the pieces of the tangram. When finished cutting, have students reassemble the construction paper square. (diagram attached) An uncut square is helpful as a guide. Next, have students assemble the commercial set. Ask students: Was this attempt different from the first attempt? How? Why?

Instruct students to work with a partner to determine the fractional relationship of each piece to the whole square. Plastic pieces work well. Have students explain their thinking in writing. Students use the *TI-15* to enter and add each fraction, providing a symbolic connection to the shape.

Students place pieces on top of one another to answer these questions:

- How many small triangles equal one medium triangle?
- How many medium triangles equal one large triangle?
- How many small triangles equal one parallelogram?
- How many small triangles equal one square?

Ask students to use tangram pieces to create designs that equal 3/8, 5/8, 3/4.

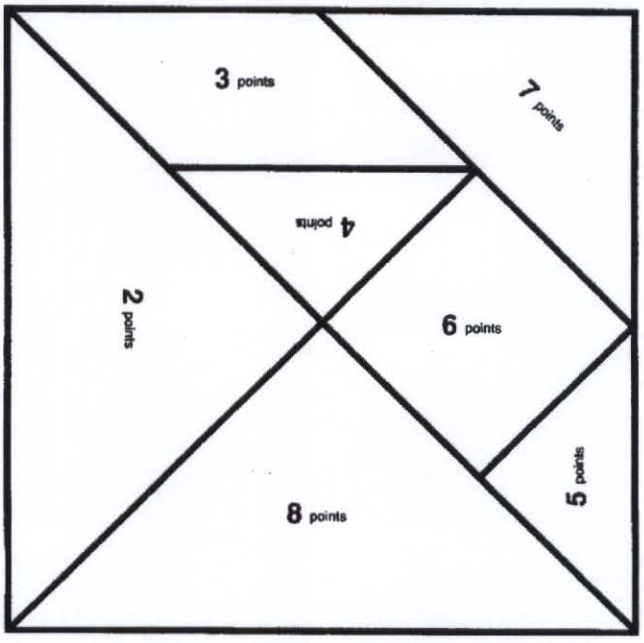
Read *The Patchwork Quilt* by Valerie Flournoy. Explain to students that they will create a quilt square of two or more colors from construction paper cut into tangram pieces. This can be assembled on an uncut square, using glue. When completed, students will calculate the fractional value of each color used. They also use the *TI-15* to explore decimal/percent values.

Extension Activities:

Students can use the tangram set with "point" values to solve these problems. Solutions can be traced and labeled on another sheet of paper.

- Use 2 pieces to make a triangle worth 10 points.
- Use 2 pieces to make a square of 9 points.
- Use 2 pieces to make a trapezoid of 10 points.
- Use 3 pieces to make a 12-point rectangle.
- Use 3 pieces to make a 16-point square.
- Use 3 pieces to create 1 15-point parallelogram.
- Use 4 pieces to make a 14-point square.
- Use 4 pieces for a rectangle that equals 18 points.
- Use 4 pieces to make a square of 20 points.
- Use 5 pieces to create a 25-point parallelogram.
- Use 5 pieces to make a trapezoid of 25 points.
- Use 5 pieces to make a 22-point rectangle.

- **Use all 7 pieces to construct a rectangle. If the side of the square piece is 3 units, what is the perimeter of your rectangle?**



Reference:

Thanks to Chris Ruda, Teachers Teaching with Technology (T3) Instructor

Tangram Pattern:

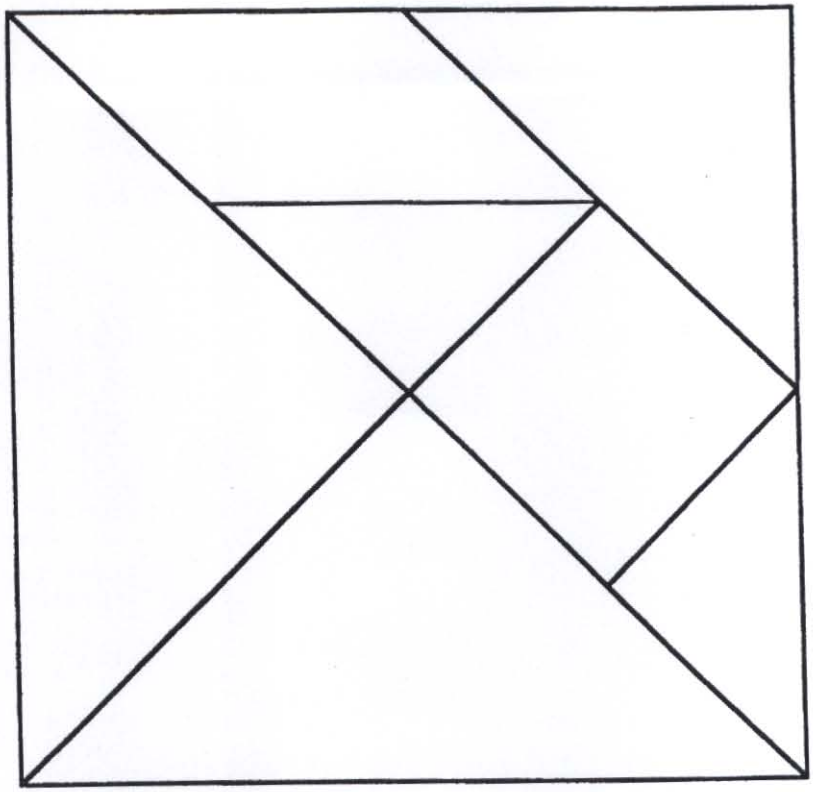
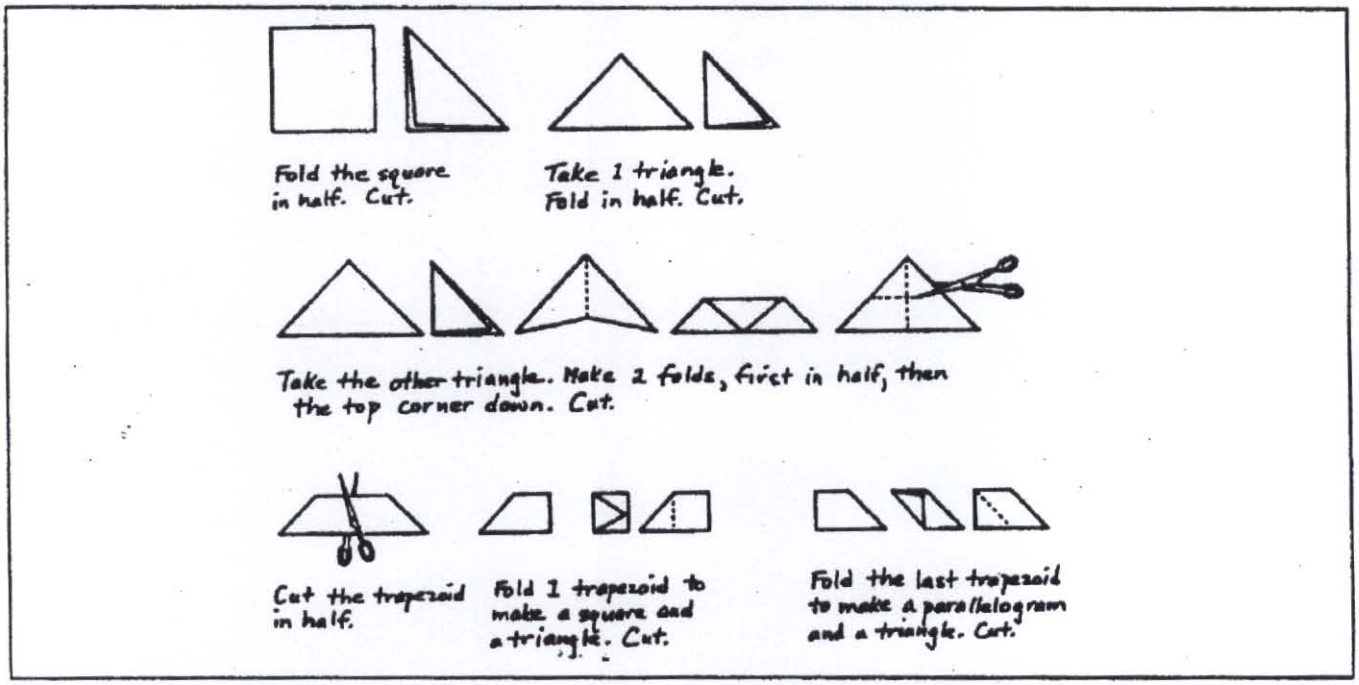


Diagram of cutting activity:



Taxicab Treasure Hunt

Standard:
Geometry: Specify locations and describe spatial relationships using coordinate geometry and other representational systems.

Materials Needed:

Computer with Internet access

Directions:

In your Internet program, open the following site: http://www.learner.org/teacherslab/math/geometry/shape/index.html. Once there, scroll down and click on Taxicab Treasure Hunt located under Activities.

Follow the directions on the page and go through each step of the Treasure Hunt.

A background sheet on this activity is attached.

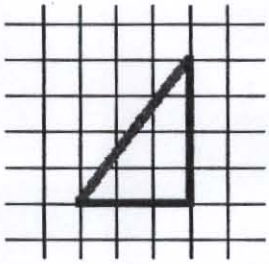
Extension Activities:

This website also contains wonderful exploratory activities on other geometry topics, like symmetry and measuring the hypotenuse. Students can explore these activities as well.

Reference:

Thanks to The Annenberg/CPB Math and Science Project and their website.

On the surface, this activity is a simple game that gives students practice with coordinates. But it is also intended as an introduction to taxicab geometry, which is a gateway to non-Euclidean geometry. If that sounds too formidable, fear not. Here's the difference: in regular, everyday (Euclidean) geometry, the shortest distance between two points is a straight line. But in a taxicab, a straight line is not always possible. You have to follow the streets. So the distance is the number of blocks you travel *along the streets.* The picture below shows a Euclidean, straight-line (red) distance of 5 (remember the Pythagorean theorem and the 3-4-5 triangle?), while the same distance in taxicab geometry (blue) is 7.



The clues you get in this activity are taxicab distances, given in blocks.

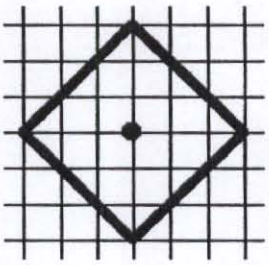
Across the Grades

Very young students can find the treasure by guess and check. Older elementary students can develop and articulate good strategies.

Underlying this activity, however, is the idea of the definition of a circle.

- In regular geometry, a circle is the set of points equidistant from a center. If this were a Euclidean treasure hunt, when you got a clue (the treasure is 30 meters away) you would know that the treasure was on a circle centered at your location with a radius of 30 meters.

- In taxicab geometry, you can make a similar statement—but the circle has a different shape. This picture shows a "taxicab circle" with a radius of three blocks.



When you get your second clue, you would then look for the intersection of two circles. In Euclidean space, these are usually two points. In taxicab space, the result is often different.

This perspective may give you good ideas for discussion questions. You may not want to define "taxicab circles," but you could ask students, after each turn, What are the possible locations for the treasure?

Exploring Transformations

Standard:
Geometry: Apply transformations and use symmetry to analyze mathematical situations.

Materials Needed:
Computer with Internet access, pencil, and paper

Directions:
In your Internet provider, open the following website: http://standards.nctm.org/document/eexamples/chap6/6.4/index.htm (an example of the page layout is attached).

There are four categories to explore

- Visualizing Transformations
- Identifying Unknown Transformations
- Composing Reflections
- Composing Transformations

Students should go through each category in that order. Ask students to read the paragraphs on each page and complete activity. Upon completion of each page, students should be creating an outline with notes of what they have learned. Students can proceed to the next category by using the NEXT link at the bottom of the pages.

Collect student outlines and discuss observations and new topics.

Extension Activities:
Students can return to each category and do further observations with the interactive figures

Students can brainstorm ideas or search the school to apply these concepts to real world examples or hands-on materials.

Reference:
Thanks to Principles and Standards for School Mathematics and their website.

Understanding Congruence, Similarity, and Symmetry Using Transformations and Interactive Figures: Visualizing Transformations


Visualizing Transformations


Identifying Unknown Transformations


Composing Reflections

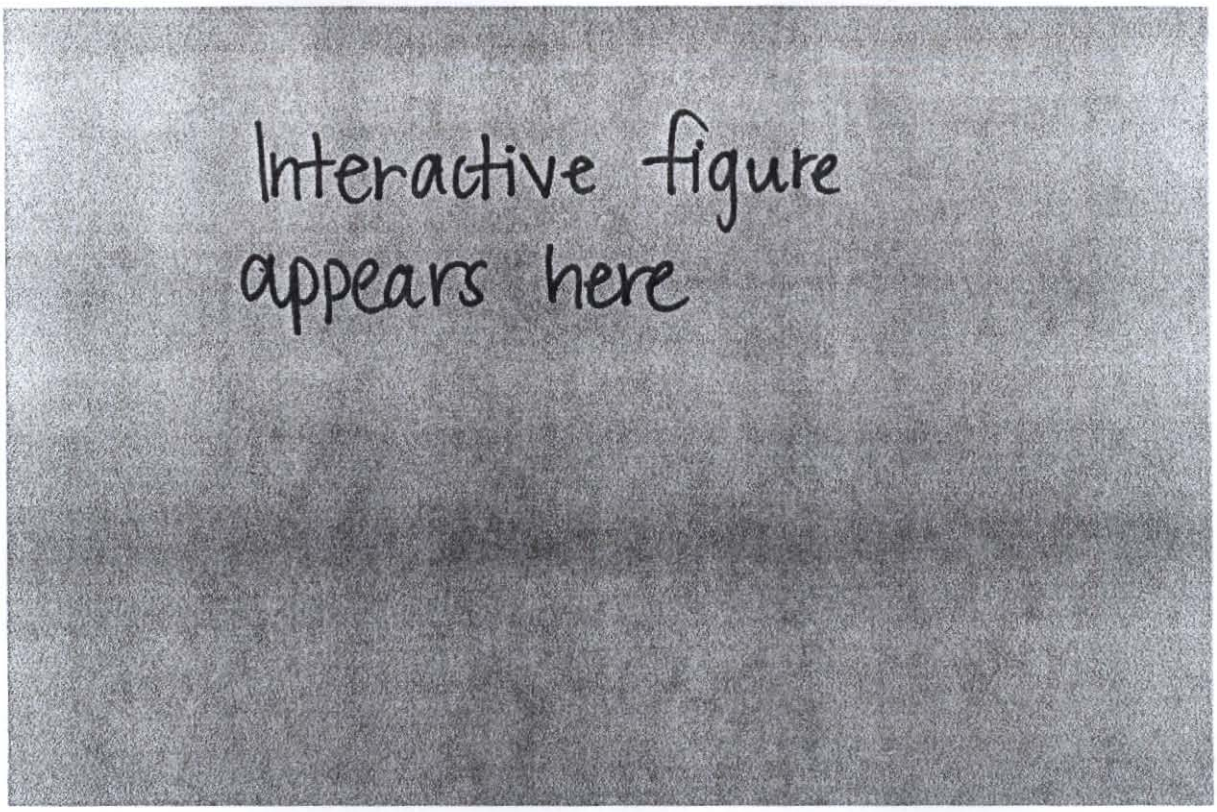

Composing Transformations

Rotations; translations, or slides; and reflections, or flips, are geometric transformations that change an object's position or orientation but not its shape or size. The interactive figures in this four-part example allow a user to manipulate a shape and observe its behavior under a particular transformation or composition of transformations. In this part, Visualizing Transformations, one can choose a transformation and apply it to a shape to observe the resulting image. In the next part, Identifying Unknown Transformations, the user is challenged to identify the transformation that has been used. In Composing Reflections, users can examine the result of reflecting a shape successively through two different lines. And in the fourth part, Composing Transformations, the users are challenged to compose equivalent transformations in two different ways. Activities like these allow students to deepen their understanding of congruence, similarity, and reflection, and they also contribute to the study of transformations, as described in the Geometry Standard.

Task

The goal of this task is to explore the effects of applying various transformations to a shape. Eventually you should be able to predict how each transformation will change the shape's image. Consider the red shape in the interactive figure below. Drag it and observe the behavior of its image, shown as a black outline. Choose a different shape, and using the same transformation, observe the behavior of its image. Change the shape of the red square or the red triangle by dragging it by an edge or vertex while pressing the "Control" key. Change the orientation by dragging the shape by a vertex. Describe the position and orientation of the resulting image in relation to the original shape. What is the relationship between the side lengths and angle measures of the original shape and those of the resulting image? Now consider the same tasks using other transformations.

[How to Use the Interactive Figure]



[Stand-alone applet]

Discussion

Dynamic geometry software allows students to visualize a transformation by manipulating a shape and observing the effect of each manipulation on its image. By focusing on the positions, side lengths, and angle measures of the original and resulting figures, middle-grades students can gain new insights into congruence. Transformations can become an object of study in their own right. Teachers can ask students to visualize and describe the relationship among lines of reflection, centers of rotation, and positions of preimages and images. Using the interactive figure, students might see that the result of a reflection is the same distance from the line of reflection as the original shape. In a rotation, students might note that the corresponding vertices in the preimage and image are the same distance from the center of rotation and all the angles formed by connecting the center to the corresponding vertices are congruent in the image and the preimage.

Take Time to Reflect
• What new insights into congruence can students gain as they work on activities like this? • What relationships between the original shape and its image are important for students to note in a translation? • What relationships between the original shape and its image are important for students to note in a reflection? • What relationships between the original shape and its image are important for students to note in a rotation?

Geometry on Sketchpad

Standard:
Geometry: Use visualization, spatial reasoning, and geometric modeling to solve problems.

Materials Needed:

Geometry's Sketchpad CD-ROM computer program published by Key Curriculum Press, Sketchpad activities (located on disk included with this packet), computer

Directions:

*Please note, you must have *Geometry's Sketchpad* on your hard drive or the CD-ROM in your computer for these activities to work.

With the disk in your computer, open the Sketchpad file called **TRIANGLE.** This activity focuses on the rule that the three angles of a triangle will always add up to 180 degrees. This sketch allows students to see that the sum of the angles of the given triangle will always equal 180 degrees no matter what, even after they physically alter the triangle sides or angles. The sum of the angles can be seen or hidden with the hide/show button at the top left corner of the screen. After altering the triangle, the new angles and sum can be recorded to the table simply by double clicking on the table.

Next, in the disk files, open the Sketchpad file called **VERTSUPP.** This activity displays the rule that vertical angles are always congruent and the lines, which show vertical and supplementary pairs of angles. This allows them to see the properties defined by the terms. Students can move the lines by clicking on a line and dragging it. As they do so, they will be able to see that the rule remains true. The angle measurements can be viewed for vertical angles and supplementary angles by the hide/show buttons.

Attached is a printout of the view of each program.

Extension Activities:

Students can use Sketchpad to create a large variety of geometric shapes and explore concepts with these shapes. Challenge students to create their own programs to have their peers complete.

Reference:

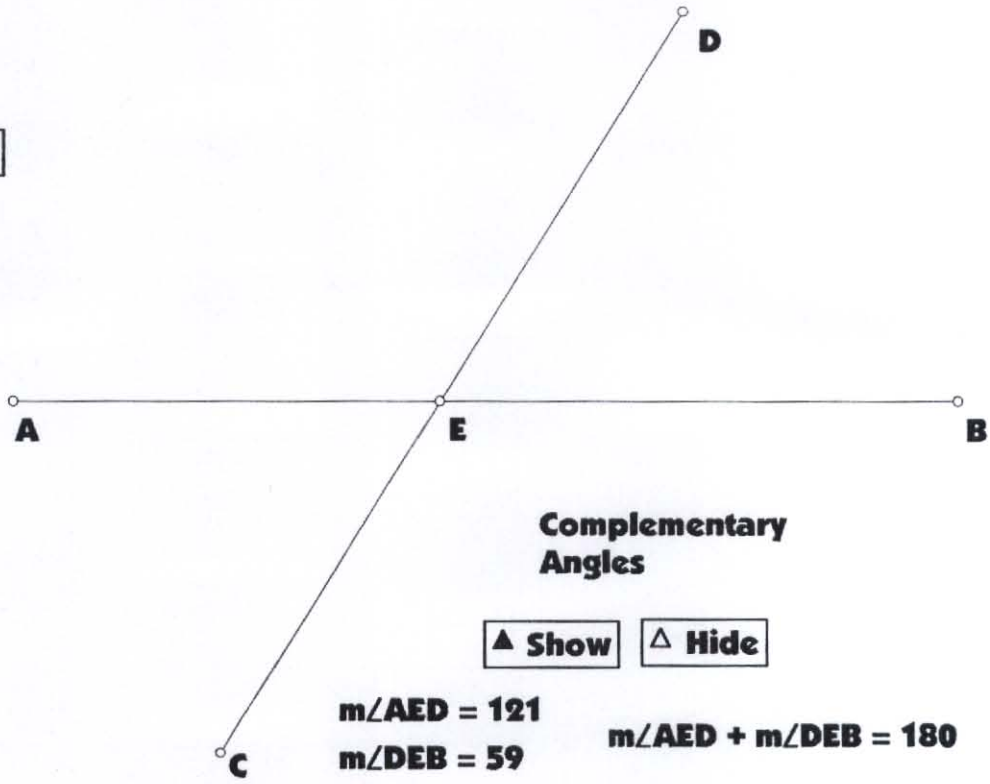
Created by Brenda Gehret with the help of MATHS 330 at Ball State University.

Vertsupp program

Vertical Angles

▲ Show | △ Hide

m∠AED = 121
m∠CEB = 121
m∠AEC = 59
m∠DEB = 59



Complementary Angles

▲ Show | △ Hide

m∠AED = 121
m∠DEB = 59

m∠AED + m∠DEB = 180

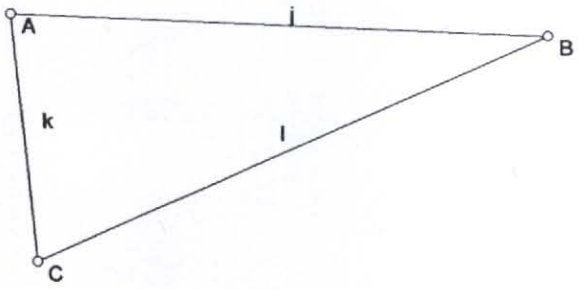
m∠AEC = 59
m∠CEB = 121

m∠AEC + m∠CEB = 180

Triangle program

m∠ABC = 27°
m∠BCA = 72°
m∠BAC = 82°
m∠ABC + m∠BCA + m∠BAC = 180°

▲ Show
△ Hide



Angle(ABC) + Angle(BCA) + An..	180.00	180.00	180.00	180.00
Angle(BAC)	71.37	45.01	52.11	81.62
Angle(BCA)	74.94	103.01	84.20	71.66
Angle(ABC)	33.69	31.98	43.69	26.72

No More Peas, Please!

Standard:
Measurement: Understand measurable attributes of objects and the units, systems, and processes of measurement.

Materials Needed: calculator, recording sheet (attached), a variety of non-standard and standard measuring tools (examples are string, tape measurers, rulers, containers, cubes, dice, marbles, counters, balance, etc.), pencil, *Counting on Frank by* Rod Clement.

Directions:

After reading *Counting on Frank*, discuss different examples of measurement in the story. One example is the number of Franks it takes to fill the bedroom is volume and measured in non-standard units. Create two lists with the class as follows: times when units of length are helpful and times when units of volume are helpful. Ask students to discuss ways to determine the number of peas the artist drew in the illustration. Have students use the number of peas in the illustration to predict the number of peas it would take to fill their classroom. Challenge the students to develop a method to find out the actual number of peas it would take to fill the classroom. Ask students to write a detailed plan for finding the number of peas it would take to fill the classroom.

While collecting and organizing data, ask them the following questions:

- What measurements are you taking? Why did you choose those?
- What measuring tools are you using? Why did you choose those?
- Are there any measurement tools on the supply table you don't think would be helpful in solving this problem? Why?
- How are you using a calculator to help with your measurements?
- How will you decide if the answer you come up with is reasonable?

Discuss the results of these plans as a whole group. Ask questions like:

- Was the illustration in the book helpful in designing a way of finding the number of peas it would take to fill this room? Why or why not?
- What measuring tools did you use?
- What measuring tools would not be helpful? Why?
- What do all the measuring tools seem to have in common?
- What problems did you experience using the calculator in this problem? How did you solve those problems?
- What was the most difficult part of this problem? Why?

- ❖ If we were to choose one method of solving this problem from among all of those suggested, which should it be? Support your suggestion with logical reasons.

Extension Activities:

Make up other measurement problems using the story *Counting on Frank*, or ask students to write problems on a card and one method of solving the problem on the other side. Share the cards among the class.

Continue and compare the problem using a tennis ball, basketball, watermelon, etc. You could also continue and compare the problem by finding the number of items to fill a larger or smaller room.

Reference:

Thanks to Texas Instrument's *Uncovering Mathematics with Manipulatives and Calculators Levels 2-3*.

Name:

No More Peas, Please!

Recording Sheet

Collecting and Organizing Data:

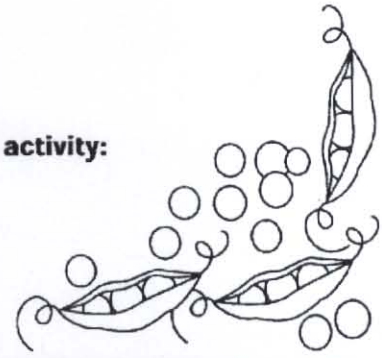
Materials we will need:

To find out how many peas it will take to fill this room, we will:

Analyzing Data and Drawing Conclusions

We think the method we chose will work because:

Questions we thought of while we were doing this activity:



Hershey Kiss Measurement

Standard:
Measurement: Apply appropriate techniques, tools, and formulas to determine measurements.

Materials Needed: Hershey Kisses, kiss worksheet (attached), ruler, calculator, scrap paper, and calendar.

Directions:

Give each student one kiss worksheet. Read through each question on the sheet with your students to be sure that they understand each question and process. Pass out appropriate materials, including rulers, yardstick, scrap paper, and calculator. Allow students to go through each question and complete the project.

Be sure that students are predicting and estimating at the appropriate times. Ask students to attempt the problems through estimation or mental math first. Upon completion, have students check their answers using a calculator.

Students will review an assortment of measurement strategies, such as perimeter, area, diameter, radius, circumference, and height, while using a variety of operations.

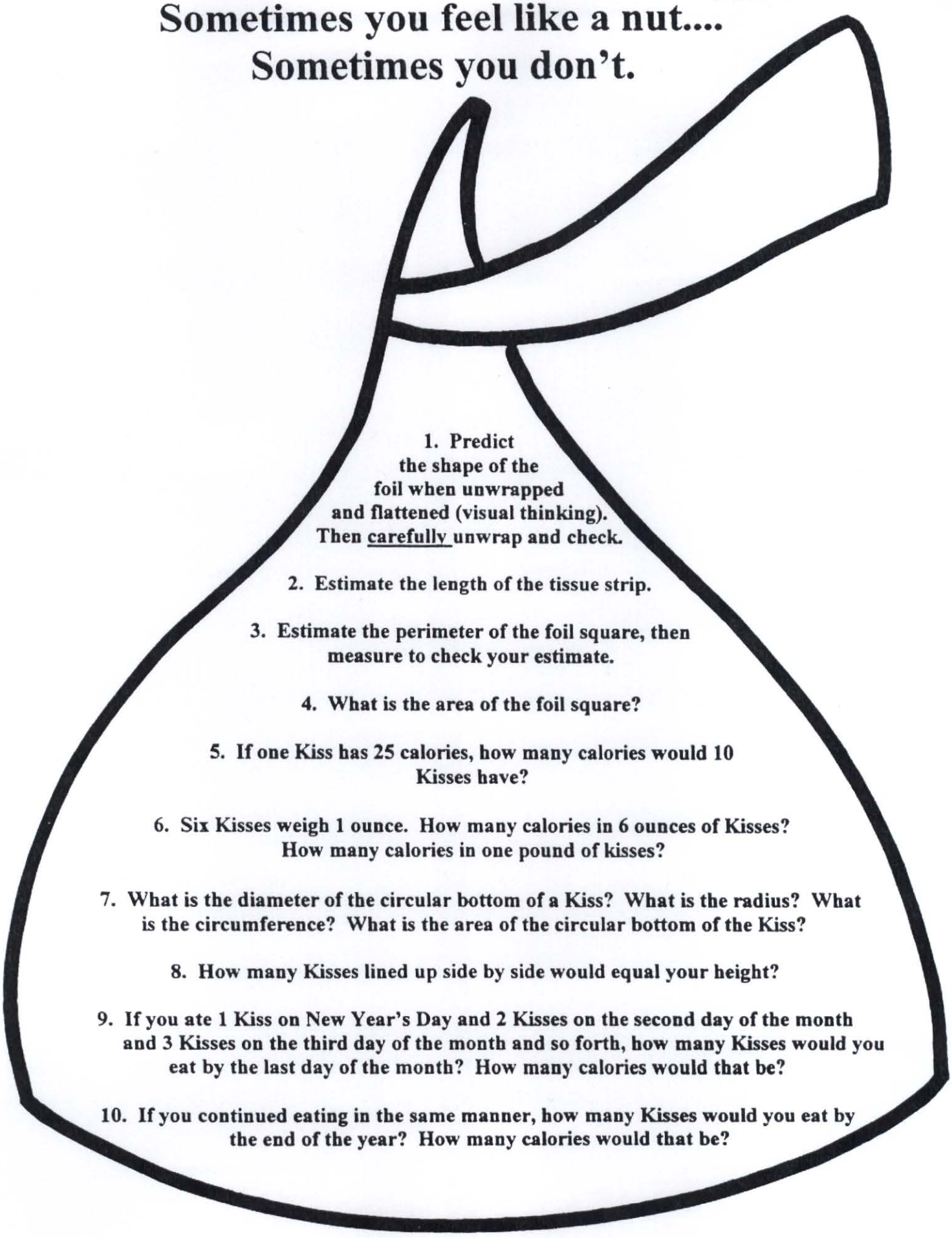
Extension Activities:

As an alternative, this activity could be used as a station in your classroom for students to use at their convenience or it could be done in small groups. This is a great activity to use during the holidays or special events in your classroom, when Hershey Kisses would be enjoyed!

Reference:

Thanks to Chris Ruda, Teaching with Technology (T3) Instructor

Sometimes you feel like a nut....
Sometimes you don't.



1. Predict the shape of the foil when unwrapped and flattened (visual thinking). Then carefully unwrap and check.

2. Estimate the length of the tissue strip.

3. Estimate the perimeter of the foil square, then measure to check your estimate.

4. What is the area of the foil square?

5. If one Kiss has 25 calories, how many calories would 10 Kisses have?

6. Six Kisses weigh 1 ounce. How many calories in 6 ounces of Kisses? How many calories in one pound of kisses?

7. What is the diameter of the circular bottom of a Kiss? What is the radius? What is the circumference? What is the area of the circular bottom of the Kiss?

8. How many Kisses lined up side by side would equal your height?

9. If you ate 1 Kiss on New Year's Day and 2 Kisses on the second day of the month and 3 Kisses on the third day of the month and so forth, how many Kisses would you eat by the last day of the month? How many calories would that be?

10. If you continued eating in the same manner, how many Kisses would you eat by the end of the year? How many calories would that be?

Addition Scramble

Standard:
Data Analysis and Probability: Formulate questions that can be addressed with data and collect, organize, and display relevant date to answer them.

Materials Needed:

Fathom CD ROM computer program published by Key Curriculum Press, Fathom worksheet for data (located on 3.5 floppy disk included with this packet), pencil, watch with second hand or stopwatch, three addition fact worksheets and data worksheet (attached), work will be done in partners.

Directions:

Divide students into groups of two. Read through the directions for collecting data on the worksheet. Students will be completing the same time tests three separate times, in ten, twenty, and thirty- second time limits. Upon completion of each group member completing the activity and recording their data in the table, students will answer questions 1 and 2. Next, they will report their data to the teacher at the computer to be entered into the Fathom table and graph.

When the entire class data is entered, print copies for students or display one copy on an overhead (an example of completed data table and graphs are attached). Next, ask students complete questions 4-7.

To enter data in the Fathom program:

- Open 3.5 floppy disk in My Computer. Inside the disk contents, double click on **Fathom Worksheet to Enter Data** to open this program. The layouts are already made. *Please note: the Fathom CDROM must be downloaded onto your computer or the CD must be in the drive in order to run this program.
- To enter the number of problems done correctly for each time period, click on the correct table, in the gray box located under the box labeled **Number.** Enter the digits to record and then push enter. It will automatically go to the next line and also create the student number. Continue this process with all three time periods to fill each table.
- As the data is entered in the table, the points will show up on the corresponding graph. Using the menu in the upper right corner you can change the style of the graph (such as dot, line, box, etc.).

Extension Activities:

Within Fathom, students can create many different types of graphs with a variety of data. Challenge students to collect their own data through surveys, observations, or experiments, and create graphs to display their data.

Reference:

Created by Brenda Gehret with the help of MATHS 330 at Ball State University.

Name: _____

Directions: Work with a partner. Fill in the chart below, according to how many problems you can get done (correctly) in the given number of seconds. One person can be the timer and grader, while the other person does the problems. Each person needs to complete both tasks. *Remember: only correct answers count!

Time in Seconds	Number of problems done correctly
10	
20	
30	

Answer these questions:

1. How many more problems did you get done in 20 seconds than you got done in 10 seconds? In 30 seconds than in 20 seconds?

   With this information, how many problems do you think you could do if you were given 40 seconds? How did you decide this?

2. How many problems are on the worksheet? By looking at your data, make an estimate on how long it would take you to do all the problems.

3. Enter your data on the computer in the Fathom program, with the help of your teacher.

4. Look at the graph of the 10-second data. What was the highest number of problems someone got right? What was the lowest?

5. By looking at the graph of 10-second data, can you tell if any people in the class got the same amount of problems done? How can you tell? And, if so, what was the number of problems and how many people got the same amount?

6. Look at the graph of the 20-second data. How many problems did the most people get right? How do you know?

7. Find the point on the graph of 30-seconds that represents your data. How does your place compare to your classmates?

5	2	4	3	7	3
+ 4	+ 3	+ 1	+ 3	+ 1	+ 5
1	8	3	2	4	1
+ 8	+ 2	+ 6	+ 7	+ 2	+ 7
5	6	4	6	1	2
+ 2	+ 1	+ 3	+ 2	+ 4	+ 4
2	1	0	5	8	1
+ 8	+ 2	+ 9	+ 3	+ 0	+ 9
4	5	4	7	3	0
+ 4	+ 5	+ 0	+ 2	+ 1	+ 2
2	3	2	1	2	1
+ 2	+ 0	+ 1	+ 1	+ 5	+ 6
0	5	1	2	3	7
+ 0	+ 1	+ 0	+ 6	+ 7	+ 0

5	2	4	3	7	3
+ 4	+ 3	+ 1	+ 3	+ 1	+ 5
1	8	3	2	4	1
+ 8	+ 2	+ 6	+ 7	+ 2	+ 7
5	6	4	6	1	2
+ 2	+ 1	+ 3	+ 2	+ 4	+ 4
2	1	0	5	8	1
+ 8	+ 2	+ 9	+ 3	+ 0	+ 9
4	5	4	7	3	0
+ 4	+ 5	+ 0	+ 2	+ 1	+ 2
2	3	2	1	2	1
+ 2	+ 0	+ 1	+ 1	+ 5	+ 6
0	5	1	2	3	7
+ 0	+ 1	+ 0	+ 6	+ 7	+ 0

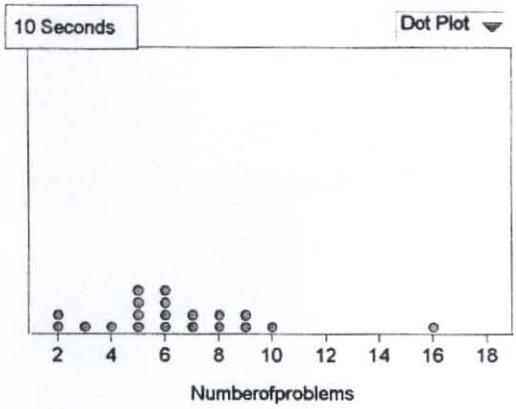
5	2	4	3	7	3
+ 4	+ 3	+ 1	+ 3	+ 1	+ 5
1	8	3	2	4	1
+ 8	+ 2	+ 6	+ 7	+ 2	+ 7
5	6	4	6	1	2
+ 2	+ 1	+ 3	+ 2	+ 4	+ 4
2	1	0	5	8	1
+ 8	+ 2	+ 9	+ 3	+ 0	+ 9
4	5	4	7	3	0
+ 4	+ 5	+ 0	+ 2	+ 1	+ 2
2	3	2	1	2	1
+ 2	+ 0	+ 1	+ 1	+ 5	+ 6
0	5	1	2	3	7
+ 0	+ 1	+ 0	+ 6	+ 7	+ 0

* Example of completed graphs and tables

10 Seconds

10 Seconds

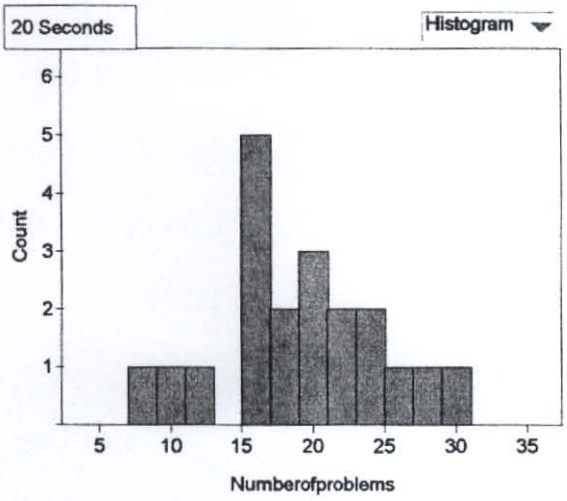
	Numberof...	<new>
14	3	
15	2	
16	7	
17	5	
18	5	
19	6	
20	8	



20 Seconds

20 Seconds

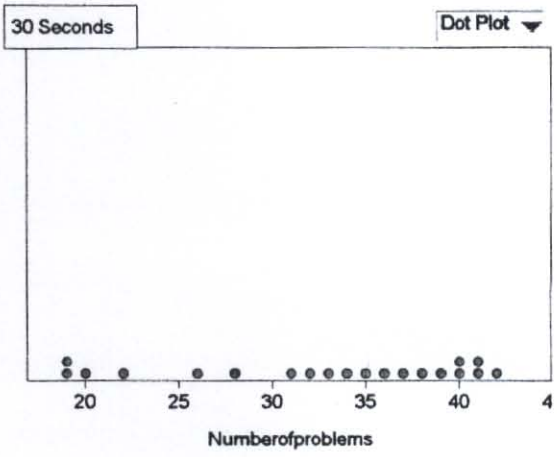
	Numberof...	<new>
14	24	
15	17	
16	15	
17	28	
18	30	
19	12	
20	20	



30 Seconds

30 Seconds

	Numberof...	<new>
1	20	
2	42	
3	19	
4	26	
5	35	
6	38	
7	39	
8	41	



How Much TV?

Standard:
Data Analysis and Probability: Select and use appropriate statistical methods to analyze data.

Materials Needed:
Calculator, worksheet and directions (attached).

Directions:
Distribute the directions and worksheet to students.
Read through the activity with the class and then ask them to complete each step of the activity. Talk about the mean, median, and mode and what these three things help tell us about a given set of data.
Collect the worksheets and discuss the results with the students.

Extension Activities:
Students can create their own problems, like the example, and these can be distributed among students in the class for completion.

Reference:
Created by Brenda Gehret.

How Much TV?

Name _____

Sixteen students estimated how much television they watched each week, to the nearest hour. Here are their results:

14, 16, 12, 14, 14, 11, 20, 12, 8, 10, 16, 15, 17, 5, 15, 10

Find the mean, median, mode of the data and draw a line plot.

Use a calculator to answer the following questions.
What is the Mean? _____

What is the Median? _____

What is the Mode? _____

Draw a Line Plot of the data below.

_____

How does your graph help you to determine the mean, median, and mode?

_____

_____

_____

_____

What Do You Think?

Standard:
Data Analysis and Probability: Develop and evaluate inferences and predictions that are based on data.

Materials Needed:
TI-83 Calculator, worksheet (attached)

Directions:
The graphing part of this activity could be completed together or individually. The questions should be completed individually.

Give each student a copy of the worksheet.

Follow each step on the worksheet to display data in a table and then on a graph. Use the table and graph to make observations and answer the given questions.

Extension Activities:
Students can create their own data and display in a graph and then develop a set of questions to accompany their information, which would allow other students to make predictions or draw conclusions about the data.

Reference:
Created by Brenda Gehret.

What Do You Think?

Name: _____

Use a *TI-83* to enter the following set of data into a table. To enter this data:

1. Begin by clearing any prior lists by using STAT 4: ClrList and then 2nd and any lists that has data (ex: L1, L2)
2. Enter new data by using STAT1: Edit then push Enter and select appropriate list. (Use list 1 for Pieces of candy eaten during week and list 2 for number of cavities).
3. Enter all digits in both lists, pushing enter after each digit. Be sure the numbers line up from list 1 and list 2 (for example, the first line of list 1 should read 2 and the first line of list 2 should read 0).
4. Press GRAPH to view the graph of the data. (The graph can be viewed closer by using the ZOOM feature of the calculator).

Pieces of candy eaten during week	Number of cavities
2	0
20	2
24	7
12	5
0	3
8	1

Using the table and the graph answer the following questions.

1. Make a sketch of the graph below.

2. By looking at the table and the graph, what justifications can you make about this topic? Why do you make these justifications?

3. Do you think any further investigation needs to be done in this study? Give reasons to support your answer.

4. If you answered yes to question 3, what further information would you want to know or what additional studies would you complete?

5. After reading this graph and looking at the data, one student made the conclusion that "it is obvious that the more pieces of candy you eat, the more cavities you will have." Do you agree with this conclusion? Why or why not?

Collecting Pens

Standard:
Data Analysis and Probability: Understand and apply basic concepts of probability.

Materials Needed:

TI-83 Calculator, worksheet with questions (attached), Using the Calculator sheet (attached), tables (attached).

Directions:

Explain the following scenario to students:

The Kellogg Company (the cereal makers) once placed a free felt-tipped marker in each box of *Kellogg's Raisin Bran* they distributed. The back of the box proclaimed:

> FREE INSIDE-BRUSH MARKER…
> You'll find one of the 6 washable colors in each specially marked package of *Kellogg's Raisin* ***Bran*** cereal.
> Start collecting all 6 NOW!

*Answer questions 1-3 in the **Questions** worksheet to get started analyzing this problem (this could be completed in groups).

If this promotion were still being conducted today, you could solve this problem by actually going out and buying boxes of cereal. This shopping trip would involve purchasing boxes of cereal and seeing which of the six markers was enclosed in each box. Your spending spree would end when you had a complete set of six pens. Since this is not practical, you need to design a simulation model that accurately reflects the essential characteristics of the shopping trip.

Have students discuss this further in groups and decide on a strategy for obtaining an approximate solution using the calculator's random numbers option. *Ask students complete questions 4-7 in the **Questions** worksheet. Next, use the **Using the Calculator** information sheet for step by step directions for using the calculator to develop a set of outcomes for receiving all six pens from the cereal boxes.

Extension Activities:

The results from tables 2, 3, & 4 can be combined into data for the entire class for further discussion on probability.

Reference:

Thanks to Texas Instrument's *Explorations, Graphing Calculator Activities for Enriching Middle School Mathematics.*

Questions

Name _____

1. Assuming that equal numbers of each of the six pen colors were randomly distributed in the packaging of the cereal by the Kellogg company, about how many boxes of cereal do you think a customer would have to buy in order to collect all six of the pens? _____
2. What do you think is the minimum number of boxes a person might have to buy to get all the pens? Explain.

   _____

   _____

   _____
3. What do you think is the maximum number of boxes a person might have to buy before getting all of the pens? Explain

   _____

   _____

   _____

****

4. What random event exists in this situation?

   _____

   _____

   _____
5. What are the possible outcomes for this random event?

   _____

   _____

   _____
6. Are the outcomes equally likely?

   _____

   _____

   _____
7. How could the calculator be used to determine the number of boxes of cereal purchased by a single customer?

   _____

   _____

   _____

Using the Calculator

Opening a box of cereal and determining which color pen is inside is an experiment with six equally likely outcomes (Red, Tan, Yellow, Blue, Green, and Violet, for example). Entering the **iPart 6rand+1** command is also an experiment with six equally likely outcomes. The outcomes from these two experiments can be matched as shown in the following table.

Table 1 Pen Colors

Pen Color	Red	Tan	Yellow	Blue	Green	Violet
IPart 6rand+1 Result	1	2	3	4	5	6

As your group may have suggested, you can simulate purchasing a box of cereal by entering **iPart 6rand +1** on your calculator with the resulting number determining which color of pen is in the box. The calculator command can be repeated until each of the six possible outcomes has been obtained. The total number of times the command was entered gives an estimate of the answer for the original problem.

Use your calculator to simulate one customer purchasing cereal and collecting a set of pens.

Calculating the Results

1. Press the **MATH** button on your TI-83 and arrow over to the **right** which will highlight **NUM**. Move down to **iPart** and push **enter** then type in the number **6**. Press **MATH** again and move the arrow to the **left** to highlight **PRB**. Move down to **rand** and push **enter**, then type in **+1** and push enter again. This will give you the first random number.
2. Press **enter** repeatedly to get additional numbers.
   - ❖ Keep a tally of the number of times each number comes up using tables 2, 3, and 4 below. When all six numbers have appeared at least once, move to the next table and repeat the simulation for two additional customers.

Table 2

Pen Color	Tally
Red (1)	
Tan (2)	
Yellow (3)	
Blue (4)	
Green (5)	
Violet (6)	

Total boxes purchased by this customer _____

Table 3

Pen Color	Tally
Red (1)	
Tan (2)	
Yellow (3)	
Blue (4)	
Green (5)	
Violet (6)	

Total boxes purchased by this customer _____

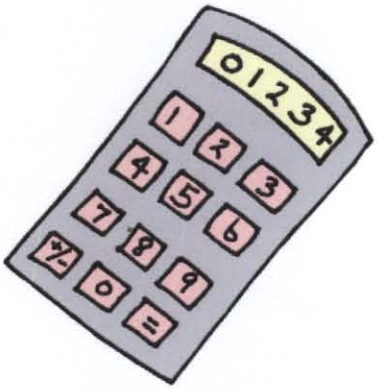
Table 4

Pen Color	Tally
Red (1)	
Tan (2)	
Yellow (3)	
Blue (4)	
Green (5)	
Violet (6)	

Total boxes purchased by this customer _____

How do you feel about getting all six colors of pens from *Kellogg's Raisin Bran?*

Technology Turnaround



Technology Turnaround

"Technology: opening minds with a new set of keys." I believe strongly that this quote from an unknown author explains the present use of technology very accurately. This quote did not really play a role in my school days, though, because I grew up in the eighties. Sitting at my desk in second, fourth, and even sixth grade during those years, I rarely ever saw or used a calculator during mathematics. If I was lucky, and sneaky, I could play around with numbers on a calculator for a few minutes during the day. Computers were around then in some classrooms, but were basically only used for typing practice and playing Oregon Trail during the forty-five minute computer segment every week. It was not until high school mathematics classes, such as Algebra, Pre-Calculus, and Calculus when I really used a calculator to help solve problems and develop mathematical concepts.

However, as I have come to learn during college from professors' lectures to the newly published textbooks, teachers are expected to use technology in teaching at all levels and to teach children to gain an understanding of technology and develop a personal commitment for using technology as a resource. This change of focus on using technology in elementary grades is a complete turnaround from only fifteen years ago. During my last four years as an undergraduate elementary education student at Ball State University, I have been taught ways of using technology while teaching. Above and beyond classes, I was selected to take part in an Honor's Undergraduate Fellowship Program with a selected professor, which has allowed me to do research and put the whole concept of the importance of technology into perspective.

In my four years of study at Ball State, as an elementary education major, I have chosen and explored a mathematics concentration. I have learned many ways to incorporate technology into teaching mathematics. Incorporating technology into teaching allows the students to have hands-on experience with technology tools, such as the calculator, computer software, and the World Wide Web interactive explorations. In fact, I spent a semester developing programs for a variety of education levels, incorporating the NCTM mathematics standards (NCTM, 2000) that could actually be used in the classroom while teaching.

One major concept that I have learned and wish my elementary teachers had known is that a calculator is more than just a checking tool for the basic computations and that a computer has many different applications besides word processor. As I have read in *Planning for D3T,* a study published by the Department of Education, "linking technology with core instructional

objectives is what makes good, effective use of technology. That's the message we need to communicate" (NCREL, 1999, p. 1). Calculators can actually be used to develop these computational skills, create graphs, and add extra challenges in problem solving. They can be used to help develop mathematical concepts and to view standards at a different angle than pencil and paper arithmetic. A computer can be used in a variety of ways now, from computer software programs in numerous topics to making learning interactive on the World Wide Web. There are an endless number of activities for a computer that would fully support and open the world of education. However, the reality of using technology while teaching in elementary classrooms is a bit more complicated than it is in theory.

Why Should Teachers Incorporate Technology Into Lessons?

As the NCTM Principles for school mathematics states, "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning" (NCTM, 2000, p. 11). In addition to enhancing learning, technology also gives teachers a chance to challenge students by elevating the level of learning (USDOE, 1996, p. 10). I used this concept during my student teaching semester, of which was completed during the fall semester of 2002 in a second grade classroom. The school system used the Saxon mathematics series, which meant that I had to use that series to teach mathematics to my students. The Saxon program has extremely little technology in the lessons. In addition to the daily Saxon lesson, my supervising teacher and I did additional lessons and activities to assist students in learning mathematics and to be challenged in the process. It was during these times that I incorporated a calculator in my lesson. During one lesson, the children were given a calculator to assist them in a story problem. The problem started out simple and by the end the children were asked to multiply fractions in a roundabout way. The students had not previously worked with multiplication or a calculator and had done little work with fractions in the past. However, students were able to figure out the answer with the help of the calculator and were then intrigued to learn about the process and do more. The student interest was at an all time high and they became eager to do more and had the ability to do so. It was amazing to see the reactions right before my eyes.

When looking at today's society, computers are everywhere! There is technology in every office building, in libraries, stores, restaurants, gas stations, construction jobs, etc. "Computers and information technologies are transforming nearly every aspect of American life"

(USDOE, 1996, p. 9). Today's society demands the use of technology in every day living. It has truly become a life skill. I cannot believe the increases that have taken place in the past fifteen years. These instruments used to be scarce. Now, nearly everyone I know owns a computer and it is used for so much more than playing Oregon Trail. There are endless possibilities with a computer. The Internet for example "can be a spark for changing and shaping student's opportunities for learning mathematics" (Ameis, 2002, p. V). Thinking about all of these developments, I can only imagine and envision all that is to come. Today's students will be the ones to use this technology first, and possibly even help develop it to higher levels! They definitely need to learn these skills to help them with their future.

Who Can Benefit from Technology?

Everyone in society can use technology. New technologies are being released every day and come out being more powerful, but also easier to use and more accessible to all. This allows help for citizens who have little knowledge of technology, in order to gain an understanding. Also available in the present are modification tools to comply with a computer for people with physical disabilities. Technology is capable of enhancing the achievement levels of all students, including students from poor socioeconomic levels. Students are able to work at their own pace while working with technology, in order to discover the concepts at their own rate and comfort level. "Students are neither held back, nor left behind by their peers" (USDOE, 1996, p. 17). This complies with the No Child Left Behind Act of 2001. Also in adherence with this commitment, technology is becoming more readily available to all students as "education programs act as technology opportunities" (USDOE, 2001, p. 1). With the arising tools and availability of technology in schools and homes across the United States, everyone can benefit from the use of technology.

Survey Results

During my research I distributed a survey to over twenty-five teachers in grades 1-9, peer pre-service teachers, and college professors. The survey was given to three different school systems, selected as a result of personal acquaintance and interest in each school. I distributed the survey in order to seek the opinions of teachers in the field, teaching the field, and preparing in the field, in order to gain more insight on actual real life experiences. I really wanted to find out more about the information that I was researching and try to figure out if the past recommendations were successfully implemented in the classrooms. The survey sought

information about what technology-training teachers had received, the type of technology available in the school systems, areas of content standards where technology is currently being used and areas of interest for use of technology. In addition, several general statements about the use of technology were enclosed and participants were asked to respond to each one. With the survey results I found that there was a mixture between using technology and not using technology and many reasons for it.

Beliefs About Technology

Although I wanted to use technology as often as possible while teaching and still believed that it was a necessity in student learning, sometimes I was unable to do so for a variety of reasons. With the results of the survey, I have learned that this is the case with many teachers. In many situations, technology is just not available in some schools due to lack of funding or interests. Some teachers have the resources available to them, but still do not use them because they pointed out that it prohibits students from learning facts, especially when only used for a work check. Numerous teachers felt that technology is taking away from knowing and understanding fundamental concepts and mastering the facts. I feel that many teachers are misguided and only think of a calculator as a checking tool, when in actuality it is a teaching tool. However, one teacher stated that "technology teaches a way paper and pencil just can't." In addition, many teachers agreed with statements such as "calculators can extend understanding," "technology is a tool for learning and teaching math and can increase students' learning opportunities, motivation, and achievement and help them acquire skills that are becoming essentials in the workplace." One teacher stated that "we live in a high-tech world and kids need to use technology," which I thought stated the facts clearly in regards to recent educational goals offered by our President.

Some common interests that the survey indicated that a number of teachers were using some Internet sites and calculator skills for challenge problems, station work, and an attempt for a different approach of learning. However, most teachers were anxious for learning more about technology, how to use it, and specific activities for the content areas of national standards. A large number of teachers were interested in professional development opportunities to help teachers learn how to use technology and then how to incorporate it in the classroom. This point is exactly the focus of my research.

With the help of what I have researched and the insights I gained through my survey, I have developed a teacher packet to be used in the classroom. The packet contains seventeen detailed activities with all necessary materials attached. Each one correlates to a sub-standard in the NCTM content standards (NCTM, 2000). These packets will be distributed to teachers who participated in my survey. I will also be publishing the activities on my personal website for Internet access. These will be appearing at www.bsu.edu/web/bmgehret.

Recommendations

As a mathematics concentration undergraduate, fresh from classes, real life experience, and a personal research project, I am fully promoting the incorporation of technology in math curriculums. When at all possible, technology should be used while teaching mathematics. By doing so, all students are able to develop concepts, practice prior knowledge, and push forward with challenging material. Most importantly, as I have witnessed a turnaround in my past fifteen years, technology is becoming a necessity. Children need to learn how to use technology around them and become comfortable enough to take the skills with them as an adult. The earlier students become aware of using technology and learning the skills, the more productive they will be in society. Technology teaches a way that we cannot, when using paper and pencil or the blackboard.

Over the past school year, I have conducted research, distributed, collected, and compiled surveys, developed a large packet of teacher resources, and it has helped me come truly more away of the need of technology in elementary classrooms. In addition, I recently attend a Teachers Teaching With Technology (T^3) conference, in which I gained an immensely larger awareness and interest in integrating technology in mathematics. The T^3 team, a part of Texas Instruments, is a wonderful, extremely informative group of people that are there to help all teachers, and I know I will personally keep in touch with the program. Just as I have been gaining professional development, I urge all teachers to seek any and all additional resources that they could use in their classrooms or schools that would help accomplish integrating technology into the math program. There is always something that can be discovered or learned that will benefit students' well-beings.

As I have come to conclude, technology is very important to use and develop with children. It can be a tremendous tool if used properly and can be remarkably beneficial to students. As I finish up my fellowship and thesis and my final year at Ball State University, I

make the promise to myself that I will continue to gain more insight on the use of technology at all times. I know that I am a lifelong learner and will constantly seek any resources that will benefit a classroom of children.

As I have been expected throughout my college career to use technology in daily lessons, activities, and assignments, I will soon be giving expectations of my own to a classroom of students. These expectations will include the use of technology, unlike the expectations that I received when I was in elementary school. After all, isn't the following true, "Technology: opening minds with a new set of keys?"

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